

## Catalytic Combustion System: A Cheaper and Cleaner Alternative



Faced with power challenges, the State of California is working with energy producers to bring to market innovative technolo-

gies that bridge the gap between power supply and demand. One promising technology funded in part through the California Energy Commission's Public Interest Energy Research (PIER) program is Catalytica's Xonon Cool Combustion system. This revolutionary product can prevent nitrogen oxides from forming in gas turbines as an air pollution prevention measure. The need for ultra-low emissions power production is critical given the strict emissions levels enforced in California's more populated areas.

Catalytica Energy Systems, Inc. of Mountain View developed the Xonon Cool Combustion system with the goal of virtually eliminating the formation of nitrogen oxides (NO<sub>x</sub>), a primary contributor to smog, while also reducing emissions of other pollutants. Xonon is also the only combustion system demonstrated to meet California Air Resources Board and South Coast Air Quality Management District emissions guidelines – among the strictest in the United States – for new Kawasaki M1A-13X 1.4 MW gas turbines, without the use of an exhaust cleanup system.

### How It Works

A gas turbine operates by compressing incoming air, combining it with fuel, and combusting the mixture. The combustion process releases the fuel's energy, forming hot gases that power the turbine. In conventional combustion systems, the temperature required to sustain a stable

flame temperature? Put simply, you have Xonon (which is "no-nox" if read backward!). Thus, unlike other NO<sub>x</sub> control technologies, Xonon prevents the formation of NO<sub>x</sub> emissions by keeping the temperature of flame and combustion below the level that permits nitrogen and oxygen to combine and form NO<sub>x</sub>.

The challenge of reducing or eliminating oxides of nitrogen from turbine exhaust has occupied researchers for more than 40 years. Researchers surmised that some kind of catalytic process would probably provide the ultimate solution, but no practical, affordable technology was expected to arrive in the near future. Now Catalytica's breakthrough technology has achieved that "ultimate solution" sooner than expected.



flame is significantly higher than the temperature at which the gas turbine is designed to operate. This excessive temperature causes the nitrogen and oxygen in the air to react, forming nitrogen oxides, a major contributor to smog production and air pollution.

What happens when you control the

### A Tested Technology

In tests at Silicon Valley Power in Santa Clara, Catalytica demonstrated that Xonon can cut Kawasaki M1A-13A gas turbine NO<sub>x</sub> emissions to an impressive 2.5 parts per million or less – significantly lower than emissions produced by other gas turbine combustion systems now available. That's welcome news for power producers, turbine manufacturers, and people with respiratory problems – or those who simply like to breathe clean air.

Power producers and utilities nationwide are looking to retrofit with this new



technology, and plans are underway to incorporate Xonon combustors into the next generation of advanced gas turbine engines, making them at least as “clean” as hydroelectric or wind-generated electric power sources. The Xonon Cool Combustion technology is being integrated into both General Electric and Kawasaki gas turbines, and Catalytica has agreements in place with these companies to commercialize and market the technology.

The California Energy Commission recently awarded \$3 million to Catalytica Energy Systems to help integrate Xonon into a small, (under 15 megawatt (MW)), multiple combustor “multi-can” gas turbine. The successful completion of this program will culminate in the commercialization of Xonon-equipped multi-combustor gas turbines. Prior funding to Catalytica from the PIER Program made possible the field demonstration of Xonon at Silicon Valley Power, which demonstrated ultra-low emissions of NO<sub>x</sub> and operated for over 8,000 hours while supplying clean power to the electric utility grid.

### The Benefits to Energy Users

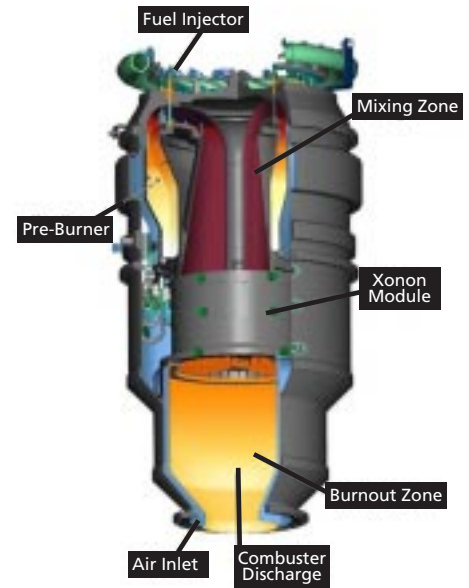
“Achieving virtually pollution-free test results indicates the efficiency and reliability of Xonon,” said Energy Commissioner Arthur Rosenfeld. “Not only can Xonon enable a gas turbine to achieve ultra-low NO<sub>x</sub> emissions, but it can do so while withstanding normal combustor operating conditions and without affecting gas turbine performance. As a commercially viable NO<sub>x</sub> control technology, Xonon will contribute in the long run to making energy cleaner and cheaper for California ratepayers.”

Technologies that can enable clean power are becoming more important both in California and nationwide as trends are shifting toward the need to site power sources close to the load. Xonon is ideal as it offers the potential to satisfy community power needs without adversely affecting air quality.

The Xonon Cool Combustion technology enters the market and California just when it is most urgently needed, for reasons involving both the distributed generation economics and the continued emphasis on air quality. For example, the proposed

new EPA standards for ozone and particulates, scheduled for adoption this summer, will push industry to reduce NO<sub>x</sub> emissions. Xonon will help industry meet both existing and new requirements. For both energy users and power producers, Xonon offers major benefits, including the significant reduction in NO<sub>x</sub> emissions from the gas turbine, cost-effective control of air pollution emissions, and elimination of potentially dangerous vibration or noise issues associated with lean-premix gas turbines.

Through PIER, the California Energy Commission works with California energy research firms to develop cost-effective, reliable, clean power technologies and alternative sources of energy. Products like the Xonon Cool Combustion technology strengthen California’s economy, increase electricity supply, protect the environment and reduce electricity costs.



### For More Information Contact:

Mike Batham  
California Energy Commission  
1516 9<sup>th</sup> Street  
Sacramento, CA 95814  
(916) 654-4548

Megan Ravel  
Catalytica Energy Systems  
(650) 940-6253

[www.energy.ca.gov/pier](http://www.energy.ca.gov/pier)